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| EXAMINER |
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LEUNG, KA CHUN A

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| ART UNIT | PAPER NUMBER |
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3747

| SHORTENED STATUTORY PERIOD OF RESPONSE | MAIL DATE | DELIVERY MODE |
|--|------------|---------------|
| 3 MONTHS | 04/09/2007 | PAPER |

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

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|------------------------------|--------------------------------------|--------------------------------------|--|
| Office Action Summary | Application No. 10/535,693 | Applicant(s) ADLER, ROBERT | |
| | Examiner Ka Chun Leung | Art Unit 3747 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 19 MAY 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 4-11 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 4-11 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>05192005 and 06142005</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Priority

1. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 4 and 8 are rejected under 35 U.S.C. 102(b) as being anticipated by PEDERSEN (US 6,095,101). PEDERSEN discloses a diesel type internal combustion engine comprising of an insulated tank (11) where liquid gas, such as propane, is provisionally stored at a temperature of approximately -42°C . As described in Column 8, Lines 28-43, when the fuel is used it passes through a suction pipe (12) and onto a compressor (13), which compresses the gas to a supply pressure typically of 400 bar in a common rail system. As further disclosed in the 2nd paragraph of Column 11, the liquid gas also may be heated by unit 51 to prevent the formation of ice inside the mantles (47).
4. Claims 4 and 8-9 are rejected under 35 U.S.C. 102(b) as being anticipated by KOBAYASHI et al (US 5,403,167). KOBAYASHI et al discloses a liquefied hydrogen

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pump (41) for a gas ignited engine (19) including a liquefied hydrogen fuel tank (1) and a heat exchanger (16). As noted in column 2, Line 53, "the hydrogen gas having a pressure of approximately 10 MPa [or 100 bar] is injected into the combustion chamber of the hydrogen ignited engine."

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

7. Claims 4 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over PEDERSEN (US 6,095,101) in view of McFEE (US 4,333,424).

8. McFEE discloses an internal combustion engine comprising of an air compressor (10), a heat exchanger (11), a fuel injector (15), and an expander having a cylinder (13) and a piston (14). McFEE further discloses in the 2nd paragraph of Column 5 that:

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"unlike a diesel, the air into which the fuel is sprayed is so hot (i.e. roughly 1200°K) that the fuel ignites and burns almost instantly, as in a furnace. The air in the expander is so hot that gaseous fuels having high ignition temperatures, such as methane and propane, can also be injected, rather than being mixed with air prior to intake as in the "dual fuel" compression-ignition engine."

However, McFEE is silent regarding the source of fuel supplied to the fuel injector.

9. PEDERSEN discloses a diesel type internal combustion engine comprising of an insulated tank (11) where liquid gas, such as propane, is provisionally stored at a temperature of approximately -42°C. As described in Column 8, Lines 28-43, when the fuel is used it passes through a suction pipe (12) and onto a compressor (13), which compresses the gas to a supply pressure typically of 400 bar in a common rail system.

10. Thus it would have been obvious to a person having ordinary skill in the art at the time the invention was made to have provided the engine of McFEE with the fuel supply method utilizing volatile organic compounds evaporated from crude oil tanks, in light of the teachings of PEDERSON, in order to provide an engine that reduces the amount of pollution reduced into the atmosphere and further is capable of utilizing liquid gas produced from Volatile Organic Compounds evaporated from crude oil.

11. Claims 5 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over KOBAYASHI et al (US 5,403,167) in view of WELCH et al (US 6,575,138).

12. KOBAYASHI et al (US 5,403,167). KOBAYASHI et al discloses a liquefied hydrogen pump (41) for a gas ignited engine (19) including a liquefied hydrogen fuel tank (1) and a heat exchanger (16). Additionally, Figure 6 discloses the use of an injection valve (25) with a plunger (25A), valve spring (25B) and valve body (25C)

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connected to an injection pump (26) and reservoir (29) via tubes (27, 28). However, KOBAYASHI et al does not disclose introducing the hydrogen fuel into the combustion chamber at pressures between 200 and 300 bar.

13. WELCH et al discloses a directly actuated injection valve for direct injection of gaseous fuel into the combustion chamber of an internal combustion engine comprising of an injection valve actuated by a solid magnetostrictive member (130). WELCH et al notes in the Background of the Invention:

“with direct injection late in the compression stroke, a high-compression ratio can be maintained, maintaining efficiency. Further when the fuel that is directly injected comprises natural gas, propane, or hydrogen, the emissions of NO_x and particulate matter (PM) are significantly reduced.”

Additionally as noted in Column 7, Line 15:

“An advantage of the present injection valve is that it may be employed for late-cycle high pressure direct injection of fuels into internal combustion engines. For example, the present injection valve may be used to inject a gaseous fuel into the combustion chamber of an internal combustion engine at pressures of between about 2000 and 5000 psi (about 13.8 and 34.5 Mpa). The present injection valve may be employed to introduce liquid fuels into internal combustion engines at even higher pressures.”

Moreover, in reference to the use of hydraulic actuators of prior art, WELCH et al states in Column 7, Line 53:

“A disadvantage of active hydraulic actuators of this type is a lag time associated with moving the hydraulic fluid into and out of the hydraulic cylinder.”

14. Thus it would have been obvious to a person having ordinary skill in the art at the time the invention was made to have provided hydrogen engine and pump of KOBAYASHI et al with a directly actuated injection valve, in light of the teachings of WELCH et al, in order eliminate the lag time associated with hydraulic actuators and

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additionally enable late-cycle high-pressure direct injection for greater efficiency and reduced emissions. Please note that the cited pressure range of 2000 psi and 5000 psi is approximately 137.9 bar and 344.7 bar, respectively.

15. Claims 6 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over PEDERSEN (US 6,095,101) in view of STONE (US 6,557,535).

16. PEDERSEN discloses a diesel type internal combustion engine comprising of an insulated tank (11), a suction pipe (12), a compressor (13), and heater unit (31) for compressing and heating a liquid gas prior to being introduced into the engine. However PEDERSEN is silent as to how unit (51) heats up the liquid gas.

17. STONE discloses a system and method for transferring heat from exhaust gasses to compressed gas fuel comprising of internal combustion engines (570, 580) connected to exhaust surfaces (550) for transferring heat to compressed gas fuel.

18. Thus it would have been obvious to a person having ordinary skill in the art at the time the invention was made to have provided the heater unit of PEDERSEN with an exhaust heat surface arrangement, in light of the teachings of STONE, in order to assist vaporization of liquefied compressed gas fuel without the use of a liquid medium (e.g. coolant) which requires a significant amount of time to reach operating temperature.

Conclusion

19. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure is listed in the attached PTO-892.

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20. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ka Chun Leung whose telephone number is (571) 272-9963. The examiner can normally be reached on 7:30AM - 4:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stephen Cronin can be reached on (571) 272-4536. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

KCL
28 MAR 2007
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Art Unit 3747

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